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Review On Abrassive Jet Drilling

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ABSTRACT

Abrasive Jet Machining (AJM) or Micro Blast Machining is a non-traditional machining process, wherein material removal is effected by the erosive action of a high velocity jet of a gas, carrying fine-grained abrasive particles, impacting the work surface. The process is particularly suitable to cut intricate shapes in hard and brittle materials which are sensitive to heat and have a tendency to chip easily. As Abrasive jet machining (AJM) is similar to sand blasting and effectively removes hard and brittle materials. AJM has been applied to rough working such as debarring and rough finishing. With the increase of needs for machining of ceramics, semiconductors, electronic devices and L.C.D., AJM has become a useful technique for micromachining.

Our project report deals with various experiments which were conducted to assess the influence of abrasive jet machining (AJM) process parameters on material removal rate and diameter of holes of glass plates using various types of abrasive particles.

The experimental results of the present work are used to discuss the validity of proposed model as well as the other models. With the increase in nozzle tip distance (NTD), the top surface diameter and bottom surface diameter of hole increases as it is in general observation of abrasive jet machining process. As the pressure increases, the material removal rate (MRR) is also increased. The present study has been introduced a mathematical model and the obtained results have been compared with that obtained from the theoretical.

Keywords: Abrasive Jet Machining,Nozzle tip,Micro Blast Machining, Tolerances. Delectability, Etching, Grinding, Honing,Polishing

1. Introduction to AJM

The conventional method of machining work-piece by formation of chips which is very inefficient and expensive methods on many counts.

In view of these adverse and limiting characteristics of above conventional machining process, considerable effort has been made during the last few decades in developing and perfecting a number of newer methods, AJM is one of them which do not produce chips like conventional machining type. Abrasive Jet Machine (AJM) is affordable costing project which is not required heavy engineering workshop. Raw material is easily available in the local market.

Abrasive processes are usually expensive, but capable of tighter tolerances and better surface finish than other machining processes chances, delectability, costs and safety aspect etc.

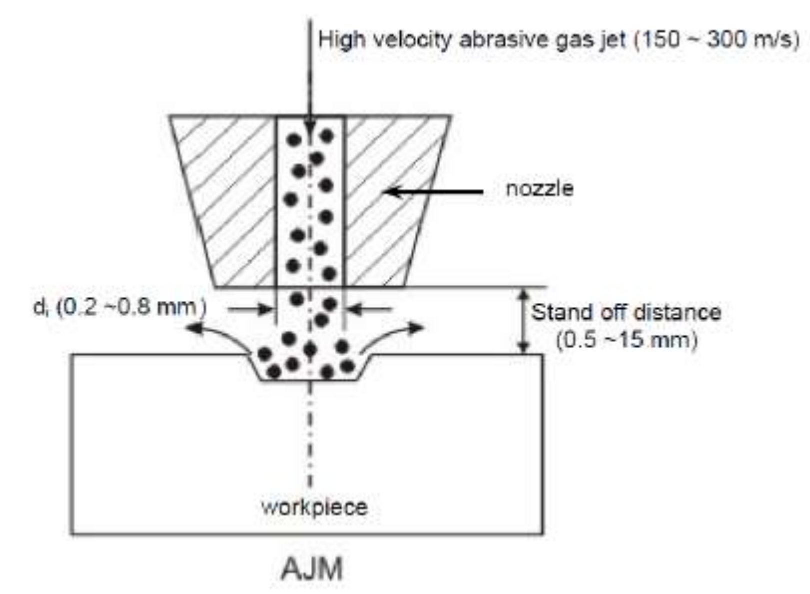

Fig. 1.1 Schematic representation of AJM

Abrasive jet machining (AJM) is a process of material removal by mechanical erosion caused by the impingementof high velocity abrasive particles carried by asuitable fluid (usually a gas or air) through a shapednozzle on to the workpiece. Common examples include Cutting, Drilling, Surface finishing, Etching, grinding, honing, and polishing.

1.2 Working principle of AJM

Fine particles are accelerated in gas stream.The particles are directed towards the focus of machining.As the particle impacts the surface, it causes a small fracture, and the gas stream carries both the abrasive particles and the fractured (wear) particles away.

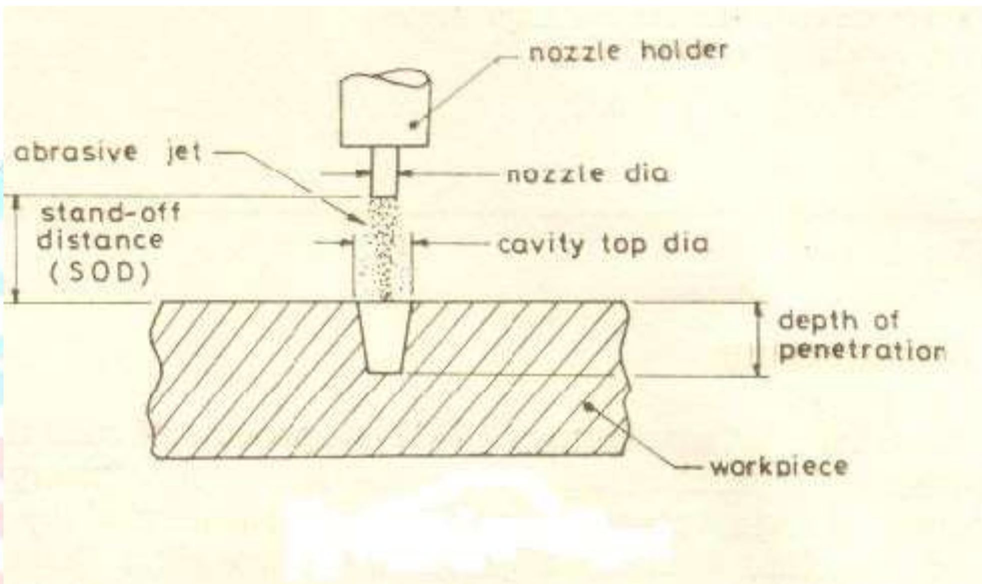

Fig. 1.2 Working principle of AJM

Abrasive jet machining (**AJM**), also known as **abrasive micro-blasting**, **pencil blasting** and **micro-abrasive blasting**.

"Abrasive blasting machining process that uses abrasives propelled by a high velocity gas to erode material from the work piece."

The working principle of Abrasive jet machining (AJM) is similar to sand blasting in which AJM effectively removes hard and brittle materials. AJM has been applied to rough working such as debarring and rough finishing.

Common uses include cutting heat-sensitive, brittle, thin, or hard materials. Specifically it is used to cut intricate shapes or form specific edge shapes.

A machining operation is basically a material removal process, where material is removed in the form of chips. In a machining operation, the output parameter is achieved by controlling various input parameters.

Drilling of glass sheets with different thicknesses have been carried out by Abrasive Jet Machining process (AJM) in order to determine its machinability under different controlling parameters of the AJM process.

2. Literature survey

The literature study of Abrasive Jet Machining reveals that the Machining process was started a few decades ago. Till date there has been a through and detailed experiment and theoretical study on the process.

Most of the studies argue over the hydrodynamic characteristics of abrasive jets, hence ascertaining the influence of all operational variables on the process effectiveness including abrasive type, size and concentration, impact speed and angle of impingement.

Other papers found new problems concerning carrier gas typologies, nozzle shape, size and wear, jet velocity and pressure, standoff distance (SOD) or nozzle tip distance (NTD). These papers express the overall process performance in terms of material removal rate, geometrical tolerances and surface finishing of work pieces, as well as in terms of nozzle wear rate. Finally, there are several significant and important papers which focus on either leading process mechanisms in machining of both ductile and brittle materials, or on the development of systematic experimental statistical approaches and artificial neural networks to predict the relationship between the settings of operational variables and the machining rate and accuracy in surface finishing.

The influence of other parameters, viz. Nozzle pressure, mixing ratio and abrasive size are insignificant. The SOD was found to be the most influential factor on the size of the radius generated at the edges.

Verma and **Lal** studied the effects of SOD on the penetration rate and cavity top diameter;they observed that penetration rate reaches an optimum value with the increase in SOD after MRR has reached its optimum.

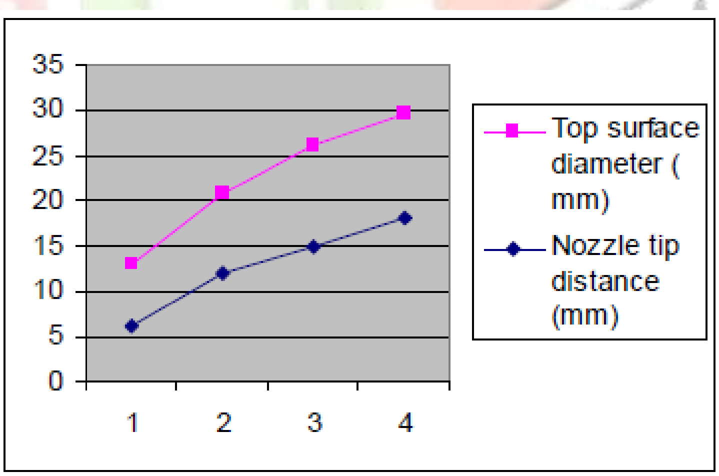

Fig.2.1 Graph Shows The Relationship Between Nozzle Tip Distance And Top Surface Diameter Of Hole At A Set Pressure Of 5.5 Kg/ cm^2

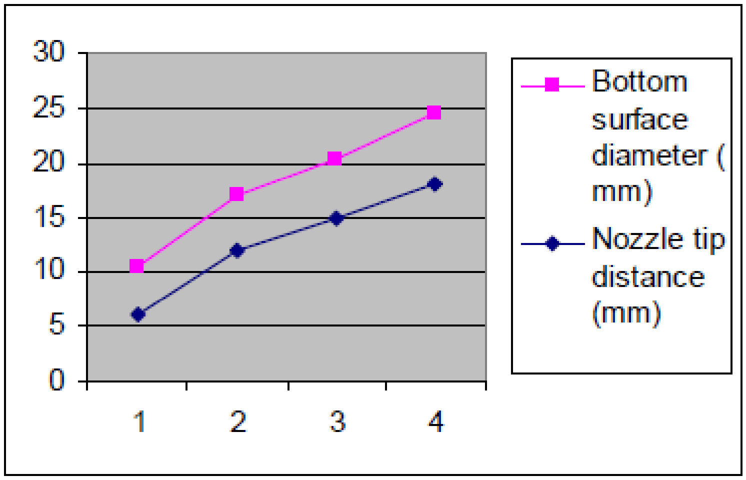

Fig.2.2 Graph Shows The Relationship Between Nozzle Tip Distance And Bottom Surface Diameter Of Hole At A Set Pressure Of 5.5 Kg/ cm^2

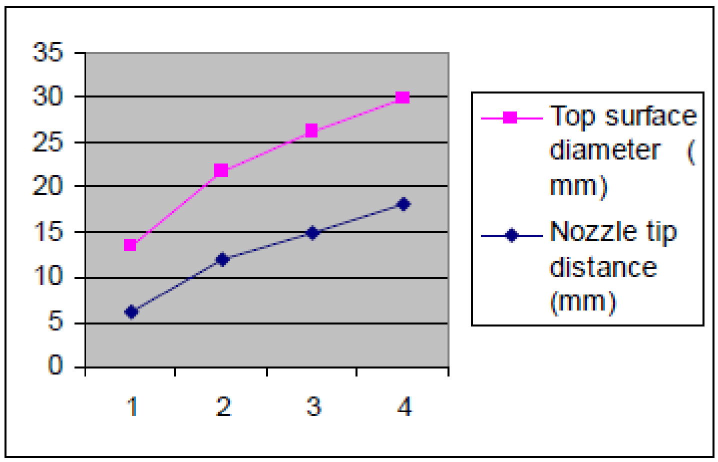

Fig.2.3 Graph Shows The Relationship Between Nozzle Tip Distance And Top Surface Diameter Of Hole At A Set Pressure 6.5 Kg/ cm^2

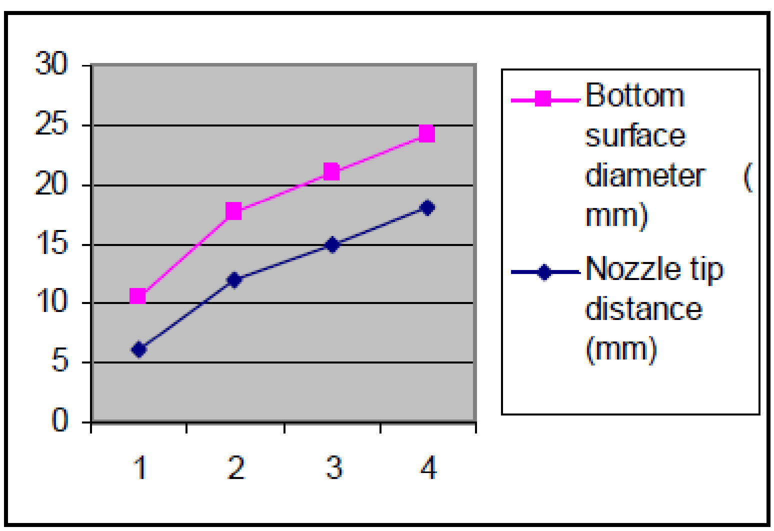

Fig.2.4 Graph Shows The Relationship Between Nozzle Tip Distance And Bottom Surface Diameter Of Hole At A Set Pressure 6.5 Kg/ cm^2

Balasubramaniam reported that as the particle size increases, the MRR at the centre line of the jet drastically increases; but the increase in the MRR nearer to periphery is very less. As the standoff distance increases, the entry side diameter and entry side edge radius also increase. Increasing standoff distance also increases the MRR.

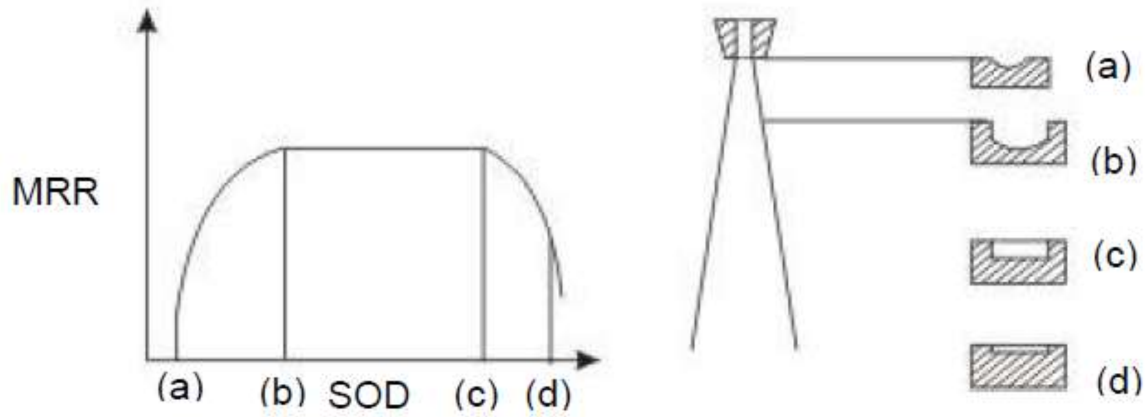

Fig.2.5 Relationship betweenStandoff Distance AndMaterial Removal Rate

F.C. Wakuda and **Yamauchi** reported that the softest abrasive, aluminumoxide leads to roughing of the alumina surface but causes no engraving, due to the lack of the abrasive hardnessagainst that of the work piece. AJM with silicon carbide abrasive produce smooth faced dimples, although itexhibits relatively low material removal rates. The material response to the abrasive impacts indicates a ductile behavior, which may be due to the elevated temperature during machining.

A.Ghobeity and **Getu** reported that the introduction of a mixing device within the pressure reservoir ensured that the powder remained loose and able to flow through the orifice to the air stream. This produced a significant improvement in AJM repeatability.

J.M. Fan reported that predictive mathematical models for the erosion rate in hole and channel machining on glasses by micro abrasive air jets on glasses are in good agreement with the corresponding experimental data. These models provide an essential basis for the process optimization of this micromachining technology to achieve efficient and effective operations in practice.

Domiaty and **Hafez** reported that cutting time decreases with increase in standoff distance. The increase of the nozzle diameter increases the MRR due to the increase of the flow rate of the abrasive particles. In the present study the cutting variables were standoff distance or nozzle tip distance of the nozzle from the work surface; work feed rate and jet pressure. The evaluating criteria of the surface produced were width of cut, taper of the cut slot and work surface roughness. It was found that in order to minimize the width of cut; the nozzle should be placed close to the work surface. Increase in jet pressure results in widening of the cut slot both at the top and at exit of the jet from the work. However, the width of cut at the bottom (exit) was always found to be larger than that at the top. It was found that the taper of cut gradually reduces with increase in standoff distance and was close to zero at the standoff distance of 4 mm. The jet pressure does not show significant influence on the taper angle within the range of work feed and the standoff distance considered. Both standoff distance and the work feed rate show strong influence on the roughness of the machined surface. Increase in jet pressure shows positive effect in terms of smoothness of the machined surface. With increase in jet pressure, the surface roughness decreases. This is due to fragmentation of the abrasive particlesinto smaller sizesat ahigher pressure and due to the fact that smaller particles produce smoother surface.

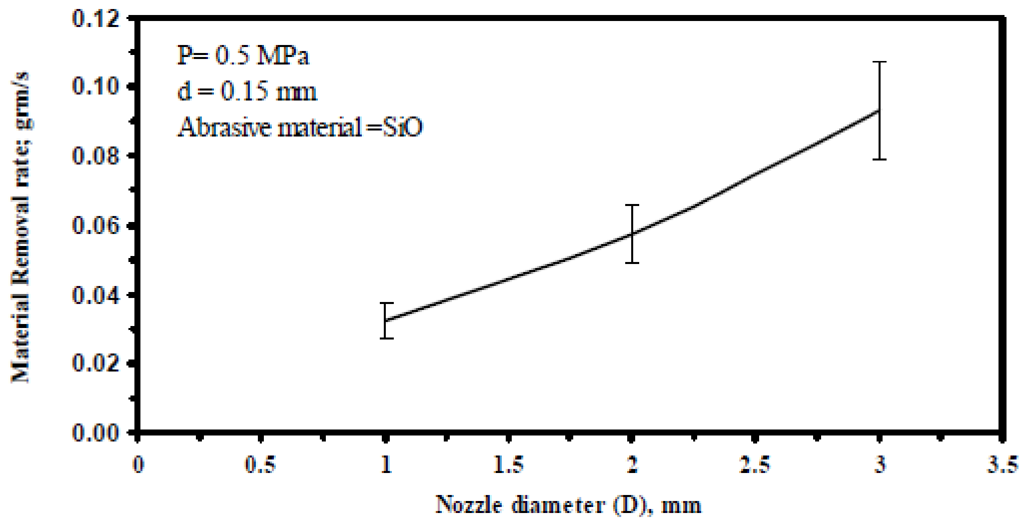

Fig.2.6 Effect Of Nozzle Diameter (D) On The Material Removal Rate Of The Glass

3.PROJECT METHODOLOGY

- Literature survey made to investigate various parameters of Abrasive Jet Machine (AJM).
- Collection of different components and materials.
- Define procedure followed during investigation of different parameters of AJM.
- AJM machine setup to obtain greater accuracy and continuous operation.
- Selection and consideration of all parameters which is affected the AJM.
- Fixed one parameter and change other parameters.
- Observe the effect of these parameters change on Material Removal Rate (MRR).
- Prepare the observation tables showing the effect of one fixed parameter on other varying parameters.
- Repeat this procedure for subsequent parameters.
- Plot the graphs from the tables.
- Obtain the conclusion by investigation of parameters.

Advantages

1. Ability to cut intricate holes shape in materials of any hardness and brittleness.
2. Ability to cut fragile and heat sensitive material without damage.
3. No change in microstructure as no heat is generated in the process.

4. The process is characterized by lower consumption and capital investment.
5. There is no contact between the tool and work-piece.
6. Good surface finish of 10 to 50 microns are possible with the process using finer abrasive.
7. Cutting action is cool because the carrier gas serves as a coolant.

Disadvantages

1. Material removal rate is low about 15 mm^3 / min.
2. The parts manufactured by this process have to be cleaned.
3. Embedding of the abrasive in the work-piece surface may occur while machining softer material.
4. The abrasive material may accumulate at nozzle and fail the process if moisture is present in the air.
5. It cannot be used to drill blind holes.
6. Nozzle wear rate is high and abrasive particles may get embedded in the work surface.
7.

Applications of AJM

1. Machining of hard and brittle materials like ceramics, quartz, glass, sapphire, mica etc.
2. Fine drilling and micro-welding.
3. Machining of semi-conductors.
4. Production of intricate profiles on hard and brittle materials.
5. Cleaning and finishing of plastic compounds. Ex. Nylon, Teflon.

4.Expected Outcomes

We will be investigate the various process parameters of AJM by using different types of work material and abrasives by changing the other parameters of AJM like pressure, Nozzle tip distance, size of abrasive grains. From that we can decide the most appropriate condition for Material Removal Rate (MRR).

Future Scope

It is very clear that AJM is greater Non-conventional machining process which is used as a multipurpose system. It is also a most effective among various affordable systems. This system is eco-friendly. Even some of the companies in India like ABB, L & T and ESSAR are already using this system with CNC programming. This system is also use as Water Jet Machining (WJM) in whichabrasives such as garnet, diamond or powders can be mixed into the water to make slurry with better cutting properties than straight water. Further development in WJM is called Hydrodynamic Jet Machining (HJM) which combines the principle of Water Jet Machining and Abrasive Jet Machining process. AJM is also used as Abrasive Flow Machining (AFM), Ultrasonic Machining (USM).

REFRENCES

1. www.elgi.com
2. www.scopus.com
3. www.4shared.com
4. www.sciencedirect.com
5. An ”EXPERIMENTAL STUDY OF ABRASIVE JET MACHINING”, A.P.VERMA and G.K.LAL
6. P C Pandey and H S Shan. 'Modern Machining Processes'.Tata McGraw-Hill publishing Co, New Delhi, 1980.
7. A Bhattacharya. 'New Technology'. The Institution of Engineers(India), 1976.
8. “Elements of workshop technology”, S K HajraChoudhury, S K Bose, A K Hajrachoudhury, Niranjan Roy, Vol-II, Media promoters and media publications.
9. “Modern machining process”, S Pandey and H N Shah, S. Chand and co.